

Discovering Math: Measurement

Teacher's Guide

Grade Level: 3–5

Curriculum Focus: Mathematics

Lesson Duration: 3–4 class periods

Program Description

Discovering Math: Measurement – From miles per gallon and metric conversion to circumference and volume, introduce elementary students to more advanced properties and concepts of measurement.

Lesson Plan

Student Objectives

- Demonstrate an understanding of the basic measures of perimeter, area, volume, capacity, weight, and angles.
- Select and use the appropriate tools and units of measurement for given situations.
- Demonstrate an understanding of the relationship between basic measures.
- Demonstrate the ability to estimate measurements.

Materials

- *Discovering Math: Measurement* video
- Boxes for measuring, several different sizes (measurements should be in inches)
- Length, Width, Height, and Volume Chart (see below)
- Perimeter and Area Shapes (see below)
- Perimeter and Area Chart (see below)
- Objects that can be weighed using a balance scale
- Balance scales
- Weight Chart
- Protractors
- Angle Examples (see below)
- Rulers

- Tape measures
- Yardsticks
- Choose the Appropriate Unit Chart (see below)
- Volume Charts (see below)
- Containers with differing volumes
- Measuring cups
- Quart container
- Gallon container

Procedures

1. Students will practice measuring length, width, height, volume, perimeter, area, weight, and angles by rotating to several measuring stations.
 - Display a box and ask students to share their ideas and strategies for finding its length, width, and height. Model how to find the length, width, and height of the box (measurements should be in inches). Ask students to share their ideas and strategies for calculating the volume of the box. Model how to calculate the volume of the box by multiplying the length by the height by the width (measurement should be in cubic inches).
 - Prior to class set up the length, width, height, and volume station with several different size boxes, measuring tools, and copies of the Length, Width, Height, and Volume Chart. After reviewing the measurements, draw students' attention to the station. Tell them when they are at the station they will measure the length, width, and height of each box and then use the measurements to find the volume of each box. They should record their information in the Length, Width, Height, and Volume Chart.
 - Draw or display a rectangle. Have students share their ideas and strategies for finding the perimeter and area of the rectangle. Model how to find the perimeter by measuring the distance around the rectangle. Remind students that perimeter is labeled in the units in which it was measured. Model how to find the area by multiplying the length and the width. Remind students that area is labeled in square units.
 - Prior to class set up the area and perimeter station with copies of the Perimeter and Area Shapes sheet, copies of the Perimeter and Area Chart, and measuring tools. After reviewing the measurements, draw students' attention to the station. Tell them when they are at the station they will use a ruler, tape measure, or yardstick to find the perimeter and area of each shape. They should record their information in the Perimeter and Area Chart.
 - Display a balance scale. Ask students to share their ideas about why they would use a balance scale. Model how to find the weight of an object using the scale. Remind

students to label the weight of the object in the units used to measure the weight (pounds, ounces, etc.).

- Prior to class set up the weight station with a variety of classroom objects to be weighed, balance scales, and copies of the Weight Chart. After reviewing the measurements, draw students' attention to the station. Tell them when they are at the station they will find the weight of each object. They should record information in the Weight Chart.
- Display a protractor. Ask students to share their ideas about why they would use a protractor. Draw or display an angle and model how to use the protractor to measure the angle. Ask a volunteer to identify an angle between 10–180 degrees and model how to use the protractor to draw the angle.
 - Prior to class set up the angle station with protractors, copies of the Angle Examples sheet, and copies of the Angle Chart. After reviewing the measurements, draw students' attention to the station. Tell them when they are at the station they will use the protractors to measure the angles. They should record information in the Angle Chart.

Allow students time to visit each station and practice measuring using the different tools and units of measurement. If time allows, the students can find other objects to measure to practice the skills.

2. Display the words inches, feet, and yards. Tell students these are units used to measure length. Remind them that different units of measurement are used in different situations. Ask students for examples of when they would use inches, feet, or yards to measure length and have them share and explain their ideas. Review that inches are used to measure very short lengths (the length of a book), feet are used to measure longer lengths (the height of a door), and yards can be used to measure even longer lengths (the length of a school bus).
 - Distribute a copy of the Choose the Appropriate Unit Chart to each student. Have them identify five objects that would be measured in inches, five objects that would be measured in feet, and five objects that would be measured in yards and record the objects in the chart. Have students identify the appropriate unit of measurement for each object. Ask them to estimate each object's length using that unit of measurement. Then have them use a ruler, tape measure, or yardstick (as appropriate) to find the actual lengths. Emphasize that the estimates should be what the students think the measurement will be and they do not need to go back and change their estimates. Tell students that when they familiar with the size of one inch, one foot, and one yard their estimates will be closer to the actual measurements.
3. Remind students how they found the volume of various boxes in the previous activity. Tell them that liquid volumes can be measured in cups, pints, quarts, or gallons. Display one cup, one pint, one quart, and one gallon.
 - Divide the class into groups of 4–6 students. Give each group one cup, one pint, one quart, and one gallon containers and a copy of the Volume Charts. Have them estimate how many cups are in one pint, one quart, and one gallon. As a group they should

discuss their ideas and record their estimates in the chart. Then have each group figure out how many cups are in one pint, one quart, and one gallon by filling the cup with water and adding it the other containers until they are full. They should record the actual measurements in the chart. Have each group share their work and strategies with the class. Ask students if they can make any other connections between the units of measurement for volume (student should be able to identify how many pints in a quart, quarts in a gallon, etc.).

- When students are comfortable with the units of measurement, distribute a variety of containers. Have each group record the unit of measurement they would use to measure the volume of each container and the estimated volume in the chart. Then ask them to find the actual volumes (some containers, like a sink may be more efficiently measured by the whole class).
- Discuss with students the importance of choosing the correct unit of measurement and the benefit of making estimates before finding the actual measurements. Remind them when they are comfortable with the units of measurements their estimates will be closer to the actual measurements.

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students were highly engaged in class discussions; produced complete charts, including all the requested information; clearly demonstrated an understanding of the basic measures of perimeter, area, volume, capacity, weight, and angles; clearly demonstrated the ability to select and use the appropriate tools and units of measurement for given measurement situations; demonstrated an understanding of the relationship between basic measures; and demonstrated the ability to estimate measurements.
- **2 points:** Students participated in class discussions; produced adequate charts, including most of the requested information; satisfactorily demonstrated an understanding of the basic measures of perimeter, area, volume, capacity, weight, and angles; satisfactorily demonstrated the ability to select and use the appropriate tools and units of measurement for given measurement situations; satisfactorily demonstrated an understanding of the relationship between basic measures; and satisfactorily demonstrated the ability to estimate measurements.
- **1 point:** Students participated minimally in class discussions; produced incomplete charts, including little or none of the requested information; did not demonstrate an understanding of the basic measures of perimeter, area, volume, capacity, weight, and angles; did not demonstrate the ability to select and use the appropriate tools and units of measurement for given measurement situations; did not demonstrate an understanding of the relationship between basic measures; and did not demonstrate the ability to estimate measurements.

Vocabulary

area

Definition: the number of square units needed to cover a surface

Context: The length of the box is 4 feet and the width is 3 feet, so the area is 12 square feet and 12 square feet are needed to cover the surface of the box.

estimate

Definition: to find a number close to an exact amount

Context: The teacher asked the students to estimate the length of the desk. They thought it looked about 11 inches long so they estimated the desk was 1 foot long.

height

Definition: the measurement of how high an object is from its bottom to its top

Context: The student measured from the bottom of the door to the top and found its height is 8 feet.

length

Definition: the measurement of how long an object is from its beginning to its end

Context: The student measured from one side of the room to the other and found its length of is 15 feet.

perimeter

Definition: the distance around a figure

Context: Two sides of a rectangle are each 4 feet long and the other two sides are each 2 feet long, so the perimeter is 12 feet.

protractor

Definition: a tool for measuring the size of an angle

Context: The teacher told the students to use a protractor to measure the size of the angles on their worksheets.

volume

Definition: the measure of the amount of space a solid figure occupies

Context: The students were able to pour 4 quarts of water into the container, so its volume is 4 quarts.

weight

Definition: a measurement of how heavy an object is

Context: The student placed the block on the scale and determined that its weight is eight pounds.

width

Definition: the measurement of how wide an object is

Context: The width of the book is four inches.

Academic Standards

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit

<http://www.mcrel.org/compendium/browse.asp>.

This lesson plan addresses the following benchmarks:

- Understands the basic measures perimeter, area, volume, capacity, mass, angle, and circumference
- Selects and uses appropriate tools for given measurement situations (e.g., rulers for length, measuring cups for capacity, protractors for angle)
- Knows approximate size of basic standard units (e.g., centimeters, feet, grams) and relationships between them (e.g., between inches and feet)
- Understands relationships between measures (e.g., between length, perimeter, and area)
- Understands that measurement is not exact (i.e., measurements may give slightly different numbers when measured multiple times)
- Uses specific strategies to estimate quantities and measurements (e.g., estimating the whole by estimating the parts)
- Selects and uses appropriate units of measurement, according to type and size of unit

National Council of Teachers of Mathematics (NCTM)

The National Council of Teachers of Mathematics (NCTM) has developed national standards to provide guidelines for teaching mathematics. To view the standards online, go to

<http://standards.nctm.org>.

This lesson plan addresses the following standards:

- Understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute
- Understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems
- Carry out simple unit conversions, such as from centimeters to meters, within a system of measurement
- Understand that measurements are approximations and how differences in units affect precision
- Explore what happens to measurements of a two-dimensional shape such as its perimeter and area when the shape is changed in some way
- Develop strategies for estimating the perimeters, areas, and volumes of irregular shapes
- Select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles
- Develop, understand, and use formulas to find the area of rectangles and related triangles and parallelograms

- Develop strategies to determine the surface areas and volumes of rectangular solids
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Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How to Use the DVD

The DVD starting screen has the following options:

Play Video—This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index—Here the video is divided into chapters indicated by title. Each chapter is then divided into four sections indicated by video thumbnail icons; brief descriptions are noted for each section. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Quiz—Each chapter has four interactive quiz questions correlated to each of the chapter's four sections.

Standards Link—Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources—This screen gives the technical support number and Web site address.

Video Index

I. Basic Measures (8 min.)

Basic Measures: Introduction

The basic measurements of length, width, height, area perimeter, circumference, volume, capacity, and mass are introduced.

Example 1: Perimeter, Circumference, and Area

Perimeter is measured by finding the sum of the sides. Circumference is the distance around a circle. Area is measured by multiplying length and width.

Example 2: Volume and Capacity

Volume is measured by multiplying the length, width, and height of the object. Capacity is the volume a container can hold.

Example 3: Mass

Mass is the amount of matter in an object, and it is measured by the force needed to move the object. The relationship between mass and weight is explained by comparing mass and weight in outer space.

II. Tools for Measurement (5 min.)

Tools for Measurement: Introduction

Using the correct measuring tools in math is important. Use a tape measure for length, a protractor for angles, and measuring cups and spoons for measuring cooking ingredients.

Example 1: Tools to Measure Length

A ruler, yardstick, or tape measure is used to measure the length of an object or short distance. Some units in the customary system are inches, feet, and yards.

Example 2: Tools to Measure Volume

Cubic feet or cubic yards are units used to measure the volume of large quantities. Measuring cups and spoons measure the volume of small quantities.

Example 3: Tools to Measure Angles

Protractors are tools used to construct and measure angles. Angles are measured in degrees.

III. Sizes of Standard Units (6 min.)

Sizes of Standard Units: Introduction

Standard units are used to make measurements. Inches measure distance, pounds measure weight, and quarts measure volume.

Example 1: Distance

Distance is measured in inches, feet, and yards. Unit conversions are explained and examples are modeled.

Example 2: Weight

Weight is measured in pounds and ounces. Conversions between pounds and ounces are explained and modeled.

Example 3: Volume

Using the customary system, volume is measured in gallons, quarts, cups, pints, and fluid ounces. Conversions are explained and modeled. Volume is measured in liters using the metric system.

IV. Areas and Perimeters (8 min.)

Areas and Perimeters: Introduction

Perimeter is the distance around the outside of a shape. Area is the amount of space inside a shape.

Example 1: Areas of Rectangles with Equal Perimeters

Perimeter is calculated by finding the sum of the sides of an object. Area is calculated by multiplying the length and width of an object. Shapes can have the same perimeter but different areas.

Example 2: Areas and Perimeters of Different-Size Squares

To calculate a square's perimeter, multiply the length of the side by four. To calculate a square's area, multiply the length of a side by itself. Different size squares have different areas.

Example 3: Areas of Circles and Squares with Equal Perimeters

The formulas for a circle's area, πr^2 , and circumference, πd , are explained and modeled. A circle with the same perimeter as a square has a greater area.

V. Variability in Measurement (7 min.)

Variability in Measurement: Introduction

Examples show variations in measurements. The instrument and technique used, who is measuring, and the stability of the object affect measurement.

Example 1: Human Variation in Measuring

Human variation can affect measurements. Holding the ruler or tape measure differently or measuring an object from a different angle results in varying measurements.

Example 2: Instrument Variation in Measuring

Instrument variation can affect measurements. Choosing the correct measuring tool for a task, ensuring instrument calibration and accuracy, and checking the zeroing of a scale can prevent instrument variation.

Example 3: Variation in Technique of Measurement

The techniques used to measure the height of Mt. Everest result in different measurements. During the past century a variety of techniques have been developed, each producing a slightly different measurement.

VI. Estimation Strategy (7 min.)

Estimation Strategy: Introduction

Scientists use estimation to find the total number in a group. Estimating is used to find the height or total number of buildings in an area. Estimation gives a close measurement.

Example 1: Estimating Height of a Totem Pole

Estimation can be used to find the total height of an object when the height of one section and the total number of sections are known.

Example 2: Estimation Work to Meet a Goal

A family uses estimation to determine how long each member must work to reach a savings goal.

Example 3: Estimating Population Size

The capture-recapture strategy is used to determine the population of birds. Scientists capture a sample of birds, release them, and recapture a second sample. They use the numbers to determine an estimated total.

VII. Selecting Units (10 min.)

Selecting Units: Introduction

The importance of choosing the correct unit of measurement is explained. Measurements must be meaningful to be useful.

Example 1: Measuring Length

Length can be measured in inches, feet, centimeters, or meters. The unit of measurement chosen is based on the size of the object being measured. The smaller the unit of measurement, the greater the number.

Example 2: Measuring Volume

In science, metric units are used to measure volume. The correct unit provides a precise measurement, is easy to work with, and allows comparison and communication of the measurement.

Example 3: Measuring Length

Length can be measured in yards, meters, miles, or kilometers. A larger unit of measurement is more useful and meaningful for long distances.

Quiz

I. Basic Measures

1. Shana's family wants to put a fence around the backyard. What measurement must they know to buy enough materials for the fence?
 - A. the area of the backyard
 - B. the mass of the backyard
 - C. the volume of the backyard
 - D. the perimeter of the backyard

Answer: D

2. Jose's room measures 12 feet long and 18 feet wide. What is the area of the room?
 - A. 30 square feet
 - B. 60 square feet
 - C. 108 square feet
 - D. 216 square feet

Answer: D

3. Marcia packs her toys in a box that measures 3 feet long, 4 feet wide, and 5 feet high. What is the volume of the box?
- A. 12 cubic feet
 - B. 20 cubic feet
 - C. 60 cubic feet
 - D. 100 cubic feet

Answer: C

4. What happens to the mass of an object when it is in outer space?
- A. The mass of the object increases.
 - B. The mass of the object decreases.
 - C. There is no mass in outer space.
 - D. The mass of the object stays the same.

Answer: D

II. Tools for Measurement

1. Ben wants to measure the length of his skateboard. What tool should he use?
- A. protractor
 - B. tape measure
 - C. measuring cup
 - D. measuring spoon

Answer: B

2. What unit of measurement would you use to measure the width of a book?
- A. feet
 - B. yards
 - C. inches
 - D. miles

Answer: C

3. A large cement truck is carrying cement for the foundation of a new house. What is the most reasonable measurement of the volume of cement in the truck?
- A. 150 cups
 - B. 150 teaspoons
 - C. 150 cubic feet
 - D. 150 square yards

Answer: C

4. What tool is used to measure and construct angles?
- A. ruler
 - B. protractor
 - C. measuring cup
 - D. measuring scale

Answer: B

III. Sizes of Standard Units

1. About how much does a bag of sugar weigh?
- A. 5 inches
 - B. 5 quarts
 - C. 5 pounds
 - D. 5 gallons

Answer: C

2. Addison's driveway is 15 feet long. How long is his driveway in inches?
- A. 45 inches
 - B. 150 inches
 - C. 160 inches
 - D. 180 inches

Answer: D

3. Gigi bought 84 ounces of bananas. How many pounds of bananas did she buy?
- A. 5 pounds
 - B. 5.25 pounds
 - C. 6 pounds
 - D. 7.25 pounds

Answer: B

4. 4 gallons = _____ quarts
- A. 8
 - B. 16
 - C. 20
 - D. 32

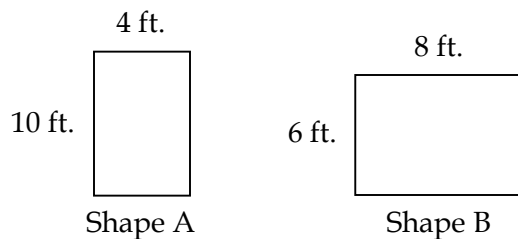
Answer: B

IV. Areas and Perimeters

1. Don's farm is 234 meters long and 537 meters wide. What is the perimeter of his farm?
A. 771 meters
B. 1,308 meters
C. 1,542 meters
D. 125,658 meters

Answer: C

2. Look at shapes A and B.



What do you know about shapes A and B?

- A. They have different perimeters and areas.
 - B. They have the same perimeters and areas.
 - C. They have the same perimeters but different areas.
 - D. They have different perimeters but the same areas.
- Answer: C*
3. Maura's backyard is the shape of a square. Its length is 45 yards. What is the area of her backyard?
A. 180 square yards
B. 360 square yards
C. 900 square yards
D. 2,025 square yards
- Answer: D*
4. Circle M and square P have the same perimeter. What do you know about the areas of circle M and square P?
A. The area of square P is equal to the area of circle M.
B. The area of circle M is less than the area of square P.
C. The area of circle M is greater than the area of square P.
D. The area of square P is greater than the area of circle M.

Answer: C

V. Variability in Measurement

1. Identify a **human variation** that could affect measurement.
 - A. the instrument calibration
 - B. a small amount of dirt on tool
 - C. using a new scientific measuring technique
 - D. holding the tape measure at a slightly different angle

Answer: D

2. Identify an **instrument variation** that could affect measurement.
 - A. the stability of object being measured
 - B. the instrument calibration is not correct
 - C. measuring an object from a different angle
 - D. holding the tape measure in a different position

Answer: B

3. Identify a **technique variation** that could affect the measurement of the height of Mt. Everest.
 - A. the instrument calibration is incorrect
 - B. the shifting plates of the Earth's surface
 - C. measuring the mountain from a different location
 - D. a new method of measuring height is developed and used

Answer: D

VI. Estimation Strategy

1. A scientist is trying to determine the total number of coyotes living in one area of southern Alaska. What strategy could the scientist use to determine the total number of coyotes?
 - A. division
 - B. estimation
 - C. subtraction
 - D. measuring the height of one coyote

Answer: B

2. Karen wants to estimate the height of the flagpole in front of her school. She knows that each of the 12 sections in the flagpole is between 4 and 5 feet tall. What is a good estimate for the height of the flagpole?
- A. 16 – 17 feet tall
 - B. 40 – 50 feet tall
 - C. 36 – 48 feet tall
 - D. 48 – 60 feet tall

Answer: D

3. Victor makes \$25 a week delivering newspapers after school. He wants to save \$450 dollars. How many weeks does Victor have to work to reach his goal?
- A. 14 weeks
 - B. 18 weeks
 - C. 20 weeks
 - D. 22 weeks

Answer: B

4. Martina's school has 14 classrooms. Each one has about 25 students. Estimate the total number of students in Martina's school.
- A. 39 students
 - B. 250 students
 - C. 350 students
 - D. 450 students

Answer: C

VII. Selecting Units

1. George is measuring the length of his new skateboard. What unit of measurement should he use?
- A. miles
 - B. inches
 - C. gallons
 - D. kilometers

Answer: B

2. Luke is measuring the volume of liquid in a small cup. What unit of measurement should he use?
- A. quarts
 - B. inches
 - C. gallons
 - D. milliliters

Answer: D

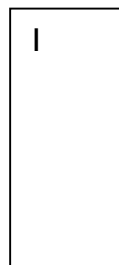
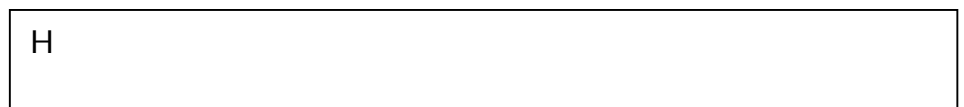
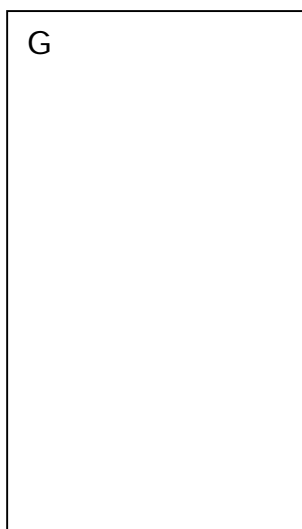
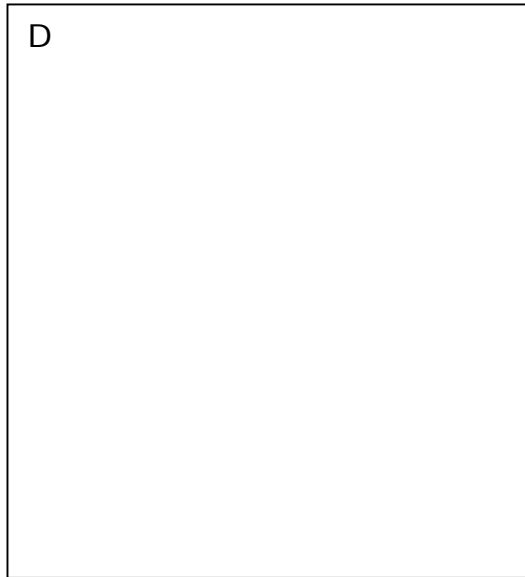
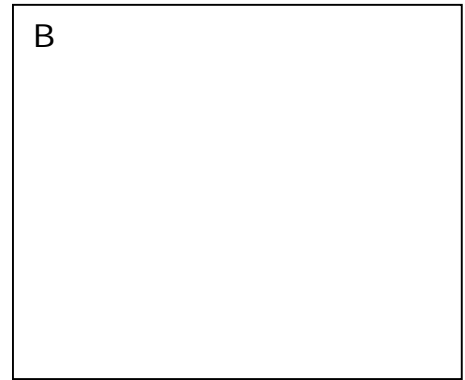
3. Which unit of measurement would be most meaningful and useful to measure the distance from Boston, Massachusetts, to Richmond, Virginia?
- A. feet
 - B. miles
 - C. yards
 - D. inches

Answer: B

Length, Width, Height, and Volume Chart

Object	Length	Width	Height	Volume

Perimeter and Area Shapes



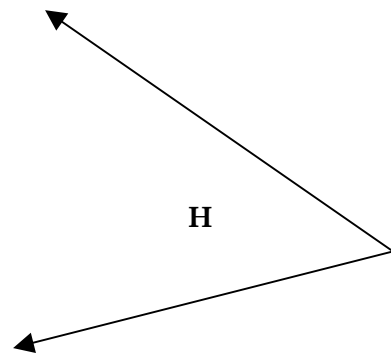
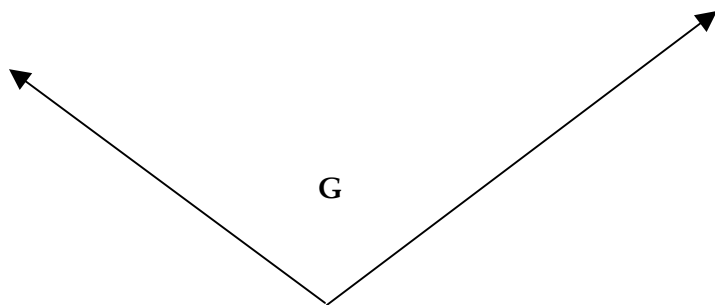
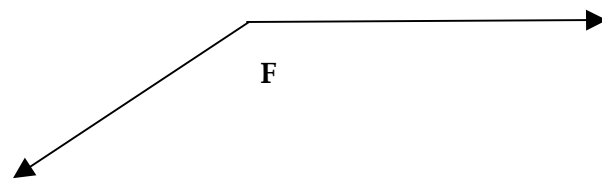
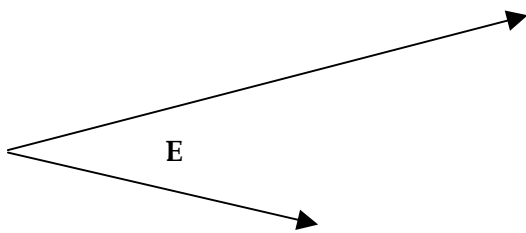
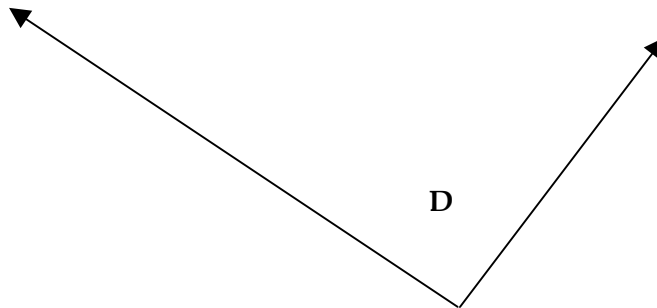
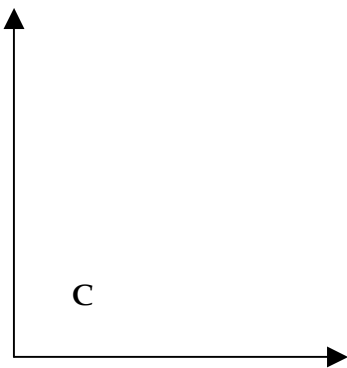
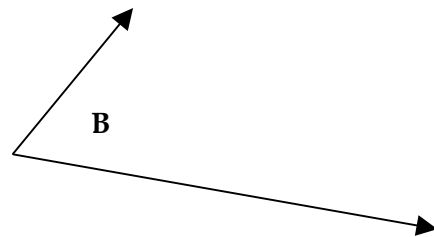
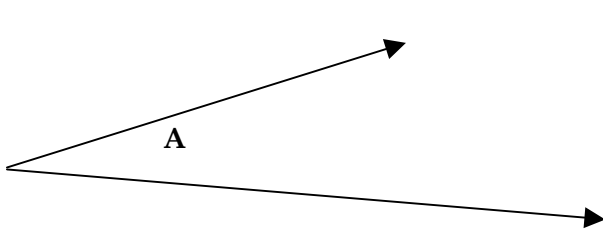
Perimeter and Area Chart

Object	Perimeter	Area
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		

Weight Chart

Object	Weight

Angle Examples



Angle Chart

Angle	Measurement
A	
B	
C	
D	
E	
F	
G	
H	

